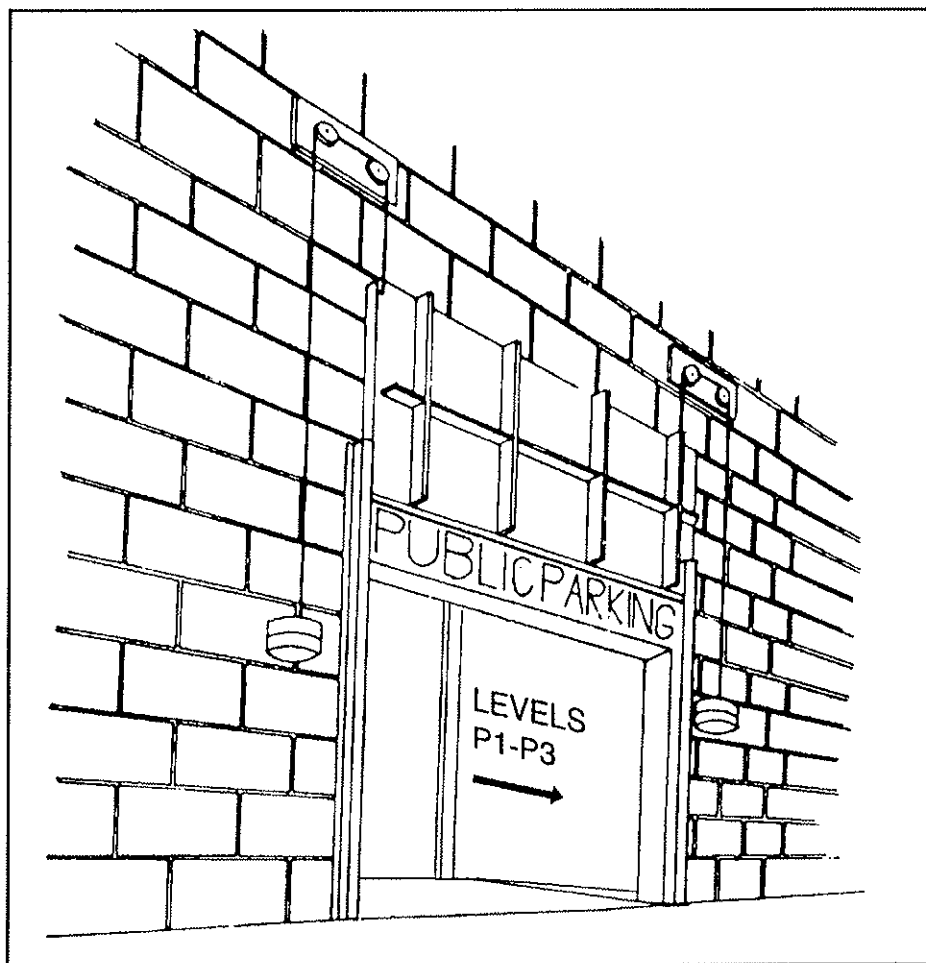




Technical
Bulletin
6-93

Below-Grade Parking Requirements
for Buildings Located in Special Flood Hazard Areas
in accordance with the
National Flood Insurance Program



FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION

FIA-TB-6
4/93

Key Word/Subject Index:

This index allows the user to quickly locate key words and subjects in this Technical Bulletin. The Technical Bulletin User's Guide (printed separately) provides references to key words and subjects throughout the Technical Bulletins. For definitions of selected terms, refer to the Glossary at the end of this bulletin.

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Any comments on the Technical Bulletins should be directed to:

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Office of Loss Reduction
Technical Standards Division
500 C St., SW, Room 417
Washington, D.C. 20472

Technical Bulletin 6-93 replaces Technical Bulletin 90-2 (draft) "Below Grade Parking Garages."

Graphic design based on the Japanese print *The Great Wave Off Karmgawa*, by Katsushika Hokusai (1760-1849), Asiatic collection, Museum of Fine Arts, Boston.

TECHNICAL BULLETIN 6-93

Below-Grade Parking Requirements for Buildings Located In Special Flood Hazard Areas in accordance with the National Flood Insurance Program

Introduction

The purpose of this bulletin is to provide technical guidance on the National Flood Insurance Program (NFIP) floodplain management requirements for below-grade parking garages for non-residential buildings in Special Flood Hazard Areas (SFHAs) shown on Flood Insurance Rate Maps (FIRMs).

Below-grade parking garages are commonly found in large engineered commercial buildings and are used for parking and access to the above-grade floors of the building. Flooding of these enclosed areas may result in significant damage to the building and any mechanical, electrical, or other utility equipment located there, such as ventilation equipment, lighting, elevator equipment, and drainage pumps. The garage walls, which often are major structural components of the building's foundation, are also susceptible to flood damage. The potential for injury to anyone in the garage, the potential for damage to parked cars, and the safety issue of removing parked cars when flooding threatens are important design considerations.

Note: Users of this bulletin are advised that it provides guidance that must be used in conjunction with Technical Bulletin 3, "Non-Residential Floodproofing — Requirements and Certification." The conditions and requirements set forth in both bulletins must be met for any below-grade parking garage to be in compliance with the minimum requirements of the NFIP regulations. A Floodproofing Certificate for Non-Residential Structures must be completed for any building in an SFHA with below-grade parking.

NFIP Regulations

The NFIP regulations provide direction concerning whether or not below-grade parking is permitted in SFHAs, both coastal and riverine. For the purposes of the NFIP, below-grade parking is considered a basement. A basement is defined as any area of a building having its floor subgrade (below ground level) on all sides. The following subsections provide applicable excerpts from the NFIP regulations.

Below-Grade Parking Garages in Residential Buildings in A Zones

Section 60.3(c)(2) of the NFIP regulations states that a community shall:

“Require that all new construction and substantial improvements of residential structures within Zones A1-A30, AE and AH on the community’s FIRM have the lowest floor (including basement) elevated to or above the base flood level.. ”

Under the NFIP, a below-grade parking garage is considered a basement if it is below grade on all sides. Therefore, the construction of below- grade parking garages is prohibited beneath residential buildings in Zones A1-A30, AE, and AH.

Section 60.3(c)(7) of the NFIP regulations deals with residential buildings in Zone AO (sheet flow with depths of 1 to 3 feet) requirements. Section 60.3(c)(7) states that a community shall:

“Require within any AO zone on the community’s FIRM that all new construction and substantial improvements of residential structures have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the community’s FIRM (at least two feet if no depth number is specified).”

Therefore, below-grade parking garages beneath residential buildings in Zone AO are prohibited.

Below-Grade Parking Garages in Non-Residential Buildings in A Zones

Section 60.3(c)(3) of the NFIP regulations states that a community shall:

“Require that all new construction and substantial improvements of non-residential structures within Zones A1-A30, AE, and AH on the community’s FIRM (i) have the lowest floor (including basement) elevated to or above the base flood level, or (ii) together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. ”

Below-grade parking garages are permitted beneath non-residential buildings in Zones A1-A30, AE, and AH provided the building (including the parking garage) is floodproofed to the base flood level in accordance with the design performance standards provided above in Section 60.3(c) (3)(ii). Only below-grade parking garages (in non-residential buildings) that are dry floodproofed are permitted under the NFIP. Guidance on floodproofing is provided in the FEMA manual “Floodproofing Non-Residential Structures” and in Technical Bulletin 3, “Non-Residential Floodproofing — Requirements and Certification.”

Section 60.3(c)(8) of the NFIP regulations deals with non-residential buildings in Zone AO (sheet flow with depths of 1 to 3 feet) requirements. Section 60.3(c)(8) states that a community shall:

“Require within any AO zone on the community’s FIRM that all new construction and substantial improvements of nonresidential structures (i) have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the community’s FIRM (at least two feet if no depth number is specified), or (ii) together with attendant utility and sanitary facilities be completely floodproofed to that (base flood) level to meet the floodproofing standard specified in Section 60.3(c)(3) (ii).”

Therefore, below-grade parking garages are permitted beneath non-residential buildings in Zone AO provided the building (including the parking garage) is floodproofed to the base flood level in accordance with the design performance standards of Section 60.3 (c)(3) (ii). Because of the

severe damage that can be caused by velocity waters and debris, below-grade parking garages are not recommended in AO zones where velocities have been identified.

Section 60.3(c)(4) further states:

“...that where a non-residential structure is intended to be made watertight below the base flood level, i) a registered professional engineer or architect shall develop and/or review structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction are in accordance with accepted standards of practice for meeting the applicable provisions of paragraph (c)(3)(ii) or (c)(8)(ii) of this section.”

The floodproofing of a below-grade parking garage and any other portion of a building below the base flood elevation (BFE) must be certified to meet the standards of Section 60.3(c)(3). Additional guidance on this certification requirement can be found in Technical Bulletin 3, “Non-Residential Floodproofing — Requirements and Certification.”

Below-Grade Parking Garages in V Zones

Section 60.3(e)(4) of the NFIP regulations states that a community shall:

“Provide that all new construction and substantial improvements in Zones VI-V30 and VE, and also in Zone V if base flood elevation data is available, on the community’s FIRM, are elevated on pilings and columns so that (i) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to or above the base flood level.”

The floor of a below-grade parking garage would be considered the “lowest floor” of a V-zone building under the NFIP (since the lowest horizontal structural member would be the footing of the garage) and could not meet the above requirement. Therefore, below-grade parking garages are prohibited beneath all residential and non-residential buildings in V zones.

It should be noted that Technical Bulletins provide guidance on the minimum requirements of the NFIP regulations. Community or State requirements that exceed those of the NFIP take precedence. Design professionals should contact the community to determine whether more restrictive local or State regulations apply to the building or site in question. All applicable standards of the State or local building code must also be met for any building in a flood hazard area.

Designing a Floodproofed Below-Grade parking Garage

All below-grade parking garages must be dry-floodproofed; therefore, hydrostatic and hydrodynamic forces must be considered in the design. In most designs, the loadings on the above-grade portion of the building are transferred to the structural elements of the below-grade parking garage. Therefore, any structural failure in the parking garage may well result in a failure of the entire

building. FEMA’s Technical Bulletin 3, “Non-Residential Floodproofing — Requirements and Certification,” must be consulted for necessary guidance on floodproofing designs for below-grade parking garages.

Note: While the NFIP regulations require that non-residential buildings be floodproofed only to the BFE, flood insurance rating procedures include a freeboard, or level of safety criterion. When a floodproofed building is rated for flood insurance, the level of flood protection is assumed at 1 foot below the top elevation of the floodproofing. For rating purposes, the NFIP requires that non-residential buildings be floodproofed to 1 foot above the BFE in order to receive rating credit for the floodproofing design.

A critical element in any floodproofing design for a below-grade parking garage is the point where the garage entrance ramp meets the street grade. The best method of protecting a dry-floodproofed garage from floodwaters is to design the garage entry to be above BFE. The entry can also be brought up and over a ramp of fill dirt placed above the BFE. In some cases, however, the garage entry must meet street grade at an elevation below the BFE. Such a design requires that a high-strength flood shield that can withstand the high hydrostatic pressure be installed so that floodwaters will not enter the dry-floodproofed garage.

Any portions of a floodproofing design that entail human intervention (such as placing a flood shield) greatly increase the potential for loss of life and property damage during a flood. A sufficient number of emergency exits must be available so that anyone in the garage will not be trapped by rising floodwaters, and a warning and evacuation plan must be developed and tested so that it can be readily implemented when a flood threatens. Such a plan is necessary for all below-grade garages as stated in Technical Bulletin 3, which provides guidance on warning and evacuation plans.

Below-Grade parking for Mixed-Use Buildings

While the NFIP regulations state that dry floodproofing of below-grade parking garages is allowed only for non-residential buildings in A zones, professionally designed buildings that have both commercial (non-residential) and residential uses may be designed with floodproofed below-grade parking garages. All residential-use areas of the building must be above the BFE. An insurance agent experienced in the NFIP should be consulted during the design phase concerning the cost of insurance for a mixed-use building.

The NFIP

The NFIP was created by Congress in 1968 to provide federally backed flood insurance coverage, because flood insurance was generally unavailable from private insurance companies. The NFIP is also intended to reduce future flood losses by identifying floodprone areas and ensuring that new development in these areas is adequately protected from flood damage. The NFIP is based on an agreement between the federal government and participating communities that have been identified as floodprone. FEMA, through the Federal Insurance Administration (FIA), makes flood insurance available to the residents of a participating community provided that the

community adopts and enforces adequate floodplain management regulations that meet the minimum NFIP requirements. The NFIP encourages communities to adopt floodplain management ordinances that exceed the minimum NFIP criteria. Included in the NFIP requirements, found under Title 44 of the Code of Federal Regulations, are minimum building design and construction standards for buildings located in SFHAs. Through their floodplain management ordinances, communities adopt the NFIP design performance standards for new and substantially improved buildings located in floodprone areas identified on FIA's FIRMs.

Technical Bulletins

This is one of a series of Technical Bulletins FEMA has produced to provide guidance concerning the building performance standards of the NFIP. These standards are contained in Title 44 of the U.S. Code of Federal Regulations at Section 60.3. The bulletins are intended for use primarily by State and local officials responsible for interpreting and enforcing NFIP regulations and by members of the development community, such as design professionals and builders. New bulletins, as well as updates of existing bulletins, are issued periodically, as necessary. The bulletins do not create regulations; rather they provide specific guidance for complying with the minimum requirements of existing NFIP regulations. Users of the Technical Bulletins who need additional guidance concerning NFIP regulatory requirements should contact the Natural Hazards Branch of the appropriate FEMA regional office. The Technical Bulletin Guide, "User's Guide to Technical Bulletins," lists the bulletins issued to date and provides a key word/subject index for the entire series.

Ordering Information

Copies of the Technical Bulletins can be obtained from the appropriate FEMA regional office. Technical Bulletins can also be ordered from the FEMA publications warehouse. Use of FEMA Form 60-8 will result in a more timely delivery from the warehouse — the form can be obtained from FEMA regional offices and your state's Office of Emergency Management. Send publication requests to FEMA Publications, P.O. Box 70274, Washington, D.C. 20024.

Further Information

The following publications provide further information concerning below-grade parking garages:

1. "Answers to Questions About Substantially Damaged Buildings," FEMA, May 1991, FEMA-213.
2. "Floodproofing Non-Residential Structures," FEMA, May 1986, FEMA-102

Glossary

Base flood — The flood that has a 1-percent probability of being equaled or exceeded in any given year (also referred to as the 100-year flood).

Base Flood Elevation (BFE) — The height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929 or other datum as specified.

Basement — Any area of a building having its floor subgrade (below ground level) on all sides.

Coastal High Hazard Area — An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave action from storms or seismic sources.

Federal Emergency Management Agency (FEMA) — The independent federal agency that, in addition to carrying out other activities, oversees the administration of the National Flood Insurance Program.

Federal Insurance Administration (FIA) — The component of FEMA directly responsible for administering the National Flood Insurance Program.

Flood Insurance Rate Map (FIRM) — The insurance and floodplain management map issued by FEMA that identifies, on the basis of detailed or approximate analyses, areas of 100- year flood hazard in a community.

Floodprone area — Any land area susceptible to being inundated by floodwater from any source.

Lowest floor — The lowest floor of the lowest enclosed area of a building, including a basement. Any NFIP-compliant unfinished or flood-resistant enclosure useable solely for parking of vehicles, building access, or storage (in an area other than a basement) is not considered a building's lowest floor.

Special Flood Hazard Area (SFHA) — Area delineated on a Flood Insurance Rate Map as being subject to inundation by the base flood and designated as Zone A, AE, A1-A30, AR, AO, AH, V, VE, or V1-V30.

Substantial damage — Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Substantial improvement — Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the “start of construction” of the improvement. This term includes structures that have incurred “substantial damage,” regardless of the actual repair work performed.



Fax cover sheet

To: <u>Bob</u>	From: <u>Daniel E. Dill</u>
Company: <u>Kent Co. Levy Court</u>	Address: <u>2025 M. Street NW Suite 450</u> <u>Washington DC 20036</u>
Date: <u>1-6-09</u>	Telephone: <u>202 721 8598</u>
Telephone: <u>302-275-0401</u>	Fax: <u>202 721 8595</u>
Facsimile:	
Number of pages including cover sheet <u>2</u>	

DILL JOB

ROSEBURG

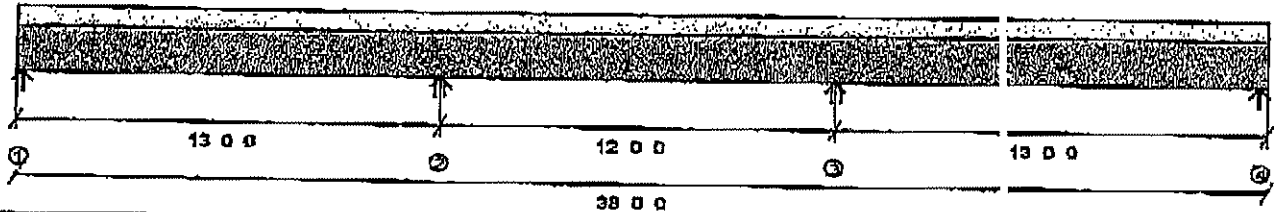
KeyBeam® 4.503g
 kmBeamPngInc 4.303h
 Material Database 779

Member Data

Description: Member Type: Beam Application: Floor
 Standard Load: Lateral Bracing: Continuous Top Building Code: IBC/IRC
 Dead Load: 10 PLF Deflection Criteria: L/360 live, L/240 total Member Weight: 14.8 PLF
 Live Load: 40 PLF Deck Connection: Nailed
 Filename: KYB1

Other Loads

Type (Description)	Begin	End	Trib. Width	Dead Start	End	Other Start	End	Category
Additional Uniform (PSF)	0' 0.00"	38' 0.00"	14' 0.00"	10		40		Live



Bearings and Reactions

	Location	Type	Input Length	Min Required	Gravity Reaction	Gravity Uplift
1	0' 0.00"	Wall	3.500"	1.500"	4290#	--
2	12' 9.375"	Wall	3.500"	2.851"	11226#	--
3	24' 9.375"	Wall	3.500"	2.851"	11226#	--
4	37' 6.750"	Wall	3.500"	1.500"	4290#	--

Maximum Load Case Reactions

Used for applying point loads (or line loads) to existing members

	Dead	Live
1	853#	3496#
2	2242#	8934#
3	2242#	8934#
4	853#	3496#

Design spans

12' 9.375"	12' 0.000"	12' 9.375"
------------	------------	------------

Product: 2.0 RigidLam LVL 1-3/4 x 11.25 3 ply
 Component Member Design has Passed Design Checks.
 Design assumes continuous lateral bracing along the top chord.

Allowable Stress Design

	Actual	Allowable	Capacity	Location	Loading
Positive Moment	12023.#	28059.#	42%	5.75'	Odd Spans D+L
Negative Moment	13477.#	28059.#	48%	12.78'	Adjacent 1 D+L
Negative Unbrd	13477.#	27585.#	48%	12.78'	Adjacent 1 D+L
Shear	5225.#	11222.#	46%	12.14'	Adjacent 1 D+L
Max. Reaction	11226.#	13781.#	81%	12.78'	Adjacent 1 D+L
TL Deflection	0.2605"	0.6351"	L/588	31.81'	Odd Spans D+L
LL Deflection	0.2171"	0.4280"	L/703	31.17'	Odd Spans L

Control: Max. Reaction

DOL: Live=100% Snow=115% Roof=125% Wind=133%

Design assumes a repetitive member use increase in bending stress: 4%

Manufacturer's installation guide MUST be consulted for multi-ply connection details and alternatives.



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*** RX REPORT ***

RECEPTION OK

JOB NO.	5033
DESTINATION ADDRESS	+2027218595
PSWD/SUBADDRESS	
DESTINATION ID	
ST. TIME	01/06 13:04
USAGE T	00' 24
PGS.	2
RESULT	OK

